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Functional Pulmonary Vein Isolation During Atrial Fibrillation Ablation

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Abstract

We report a case of apparent isolation of the right inferior pulmonary vein during atrial fibrillation ablation coincident with the onset of an atrial tachycardia. This report highlights the importance of assessing pulmonary vein conduction during sinus or paced rhythm at relatively long cycle length, rather than in atrial fibrillation or atrial tachycardia.

Case Presentation

A 48-year-old man with a history of symptomatic paroxysmal atrial fibrillation (AF) resistant to anti-arrhythmic drug therapy was referred for AF ablation. The baseline rhythm was AF at the outset. A 3-dimensional electroanatomic map was created (CARTO-3, Biosense Webster Inc., Diamond Bar, CA) of the left atrium (LA), pulmonary veins (PVs) and left atrial appendage. Wide area encirclement of the PVs was performed using a 3.5 mm irrigated-tip radiofrequency ablation catheter (Thermocool SF, Biosense Webster Inc.) during simultaneous recording of PV signals with a PV circular mapping catheter (Lasso 2515, Biosense Webster Inc.). The left superior and inferior PVs were isolated successfully with an antral encircling lesion. During encirclement of the right PVs, AF regularized and terminated to normal sinus rhythm, before complete right PV isolation was achieved. During the final lesions at the antrum of the right inferior PV (RIPV) to complete the encircling lesion, an atrial tachycardia (cycle length = 265 msec) initiated with an atrial ectopic beat distant to the right PVs, with spontaneous loss of RIPV electrical activity (Figure 1). Following electrical cardioversion, recovery of RIPV activation during sinus rhythm and left atrial pacing was noted. In order to examine the conduction properties of the RIPV connecting sleeve, left atrial pacing at progressively shorter cycle lengths was performed with measurement of the duration between stimulus artefact and the earliest PV electrogram. Decremental conduction into the vein was demonstrated with pacing at 600 and 400 ms cycle lengths (Figure 2 panel A and B respectively). During a 350 ms drive train, 2:1 conduction into the RIPV was observed (Figure 3).

Key Words:
Pulmonary vein isolation; Catheter ablation; Atrial tachycardia

Disclosures:
None.

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Discussion

The recurrence of conduction into the RIPV during sinus rhythm and left atrial pacing suggests concealed penetration of the atrial tachycardia into the remnant connecting muscle sleeve conducting into the RIPV as the mechanism of apparent isolation. This functional block is likely explained by reversible local tissue damage, possibly related to radiofrequency energy application to nearby tissue. An alternative possibility for such a finding is an incidental return of conduction over this connecting muscle sleeve following electrical cardioversion back to sinus rhythm.[1]

Evaluation of PV isolation during ablation of AF has obvious implications in terms of clinical efficacy.[2] PV isolation should be differentiated from functional block. Therefore the evaluation for complete PV isolation should be confirmed in sinus or paced rhythm at relatively long cycle length, and not during atrial tachycardia or AF. Once the visual gap in the circumferential ablation line was closed, complete right PV isolation was achieved. This lends support to the findings of Miller et al,[3] demonstrating the importance of a complete circumferential lesion to achieve durable PV isolation.

References:

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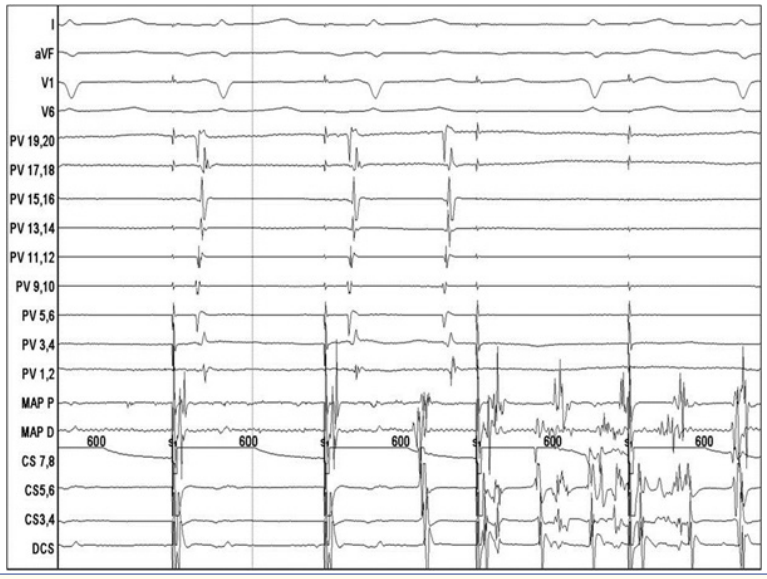

Figure 1: **A: Initiation of an atrial tachycardia with an atrial beat distant to the right inferior pulmonary vein (RIPV), associated with conduction block in to the RIPV. The circular catheter is placed at the ostium of the RIPV and the ablation catheter is positioned inferior to the RIPV at the site of the visual gap in the circumferential right-sided lesion set. From top to bottom are; surface ECGs I, aVF, V1-V6; Circular mapping catheter from proximal poles (19-20) to distal poles (1-2); Mapping catheter, proximal to distal poles; coronary sinus from proximal (7-8) to distal (1-2) poles.**

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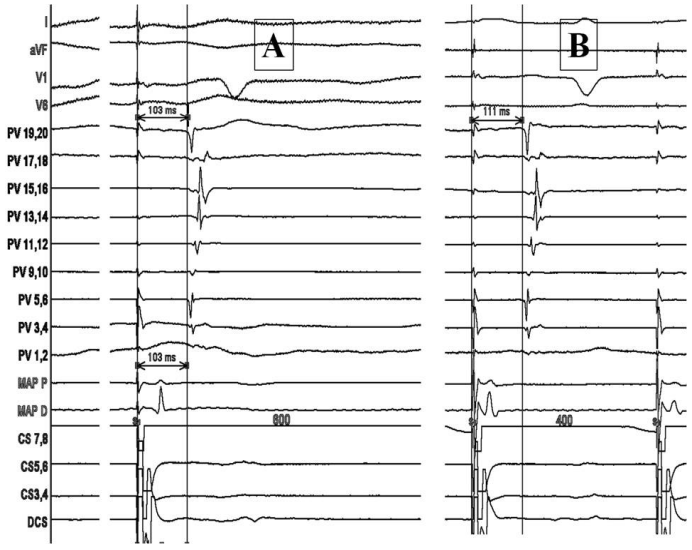

Figure 2: **A and B: Progressive decrementation at pacing at 600 ms and 400ms with stimulation-to-PV signal intervals of 103 and 111 ms respectively.**

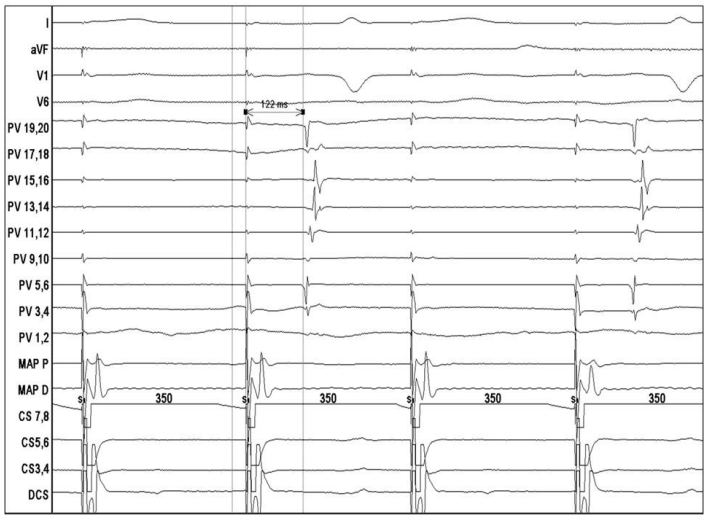

Figure 3: **2:1 conduction into the RIPV with pacing at 350ms with stimulation-to-PV signal interval of 122ms**